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ABSTRACT

Computing at Stanford University has, until recently, been performed at one of five facilities. The Stanford hospital operates an IBM 370/135 mainly for administrative use. The university business office has an IBM 370/145 for its administrative needs and support of the medical clinic. Under the supervision of the Stanford Computation Center are three facilities: ACME with a 360/50 to provide computer support for medical research, Stanford Linear Accelerator Center (SLAC) has a 360/91, and the campus facility tries to provide flexibility for general use with a 360/67. There have been moves toward changing the facilities and administrative structure of computing at the university. With separate computing support for the hospital, clinic, and medical research areas, it was proposed that these facilities be consolidated to form a central computer center for medical use. SLAC also needed an expansion of its facility. In April 1973, all facilities were unified under a central administration and soon there will be just two computer centers, one on campus and one at SLAC. (WH)

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ADMINISTRATION OF COMPUTER RESOURCES

by Gene F. Franklin

I've been inspired to choose my text as biblical from the book of Matthew, Fifth Chapter, Verses 11 and 11a. The first verse is for directors of computer centers: "Blessed are ye when men shall revile you falsely and shall say all manner of evil against you falsely." Verse 11a, for those expected to be relieved of all their computer difficulties reads: "Blessed is he who expects nothing for he shall not be disappointed." This paper will describe briefly some of the background and recent decisions affecting computing at Stanford and to note a few lessons that might be learned from the Stanford experience.

Computing Services before 1973

A few years ago Stanford had three computer organizations and five general computer facilities, in addition to the special facilities like the Artificial Intelligence Laboratory that John McCarthy runs in the Department of Computer Science. Stanford owns and operates a substantial hospital in conjunction with the medical school. For patient billing, general accounts and other administrative functions, the hospital had a data processing department which has reported to the hospital financial officer. In the hospital data processing department an IBM 360 was replaced by an IBM 370/135 operating under the disk operating system DOS with a special monitor called the Shared Hospital Accounting System or SHAS. In this facility a negligible systems programming staff, sizeable group of applications programmers and a data control section census updates and posted chargeable items daily on a machine generally

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tuned for the particular financial support of a university hospital.

The university office of business and finance uses an IBM 370/145 (also a disk operating system) running COBOL programs in support of finance and student services such as registration and student aid. In addition, this facility supports the development office in a major campaign seeking $300 million for Stanford University, provides accounting support for faculty engaged in research under federal government contracts and privately sponsored contracts, and supports academic planning. Finally, this facility ran a sizeable billing service for the physicians on the faculty of the medical school who operate the Stanford University medical clinic. This facility, like the hospital computer facility, was tuned to the requirements of a particular group of users and rendered a particular style of service. Somewhat unusual for such a center was the fact that a significant advanced development program in computer support for University administration (INFO) was being conducted in the Management Systems Office under Michael Roberts, Director, and John Gwynn.

In the area of academic computing in support of research and instruction, the Stanford Computation Center - which reported to the provost who is the chief academic officer at Stanford - operated three computer facilities. The most specialized of these, ACME, used a 360/50 with substantial support from the NIH to provide computer support for medical research. Implemented by Gio Wiederhold and his staff, the single language, terminal-oriented facility aimed to be so easy to use that the physician-researcher would do most of his own programming and maintain control over and have access to his own data and data files. The facility had extensive provision for data collection and plotting

including a centralized analog to digital conversion facility, and a graphic support software for a variety of devices including plotters, CRT displays, and the like. The specialized machine configuration for ACME included a minimum of high speed memory, but two million bytes of low speed core which was rather unusual five years ago in a model 50. The language processor, PL/ACME, was a re-entrant, core resonant, variant of PL-1 running under IBM's operating system OS MVT. A small systems staff which also ran a consultant service for physicians and users, maintained the processor and the locally designed software.

Also managed by the Stanford Computation Center was the Stanford Linear Accelerator Center (SLAC) computer facility operated by Stanford for the Atomic Energy Commission as a national research facility in physics. The SLAC IBM 360/91 operated mainly FORTRAN as a number cruncher for a relatively small number of highly sophisticated users. A substantial systems programming staff, who were charged to be at the forefront of scientific computing, also maintained an extensive tape library of user data and wrote a text editor and remote job entry system, WYLBUR, which is now available at a number of computing centers around the country.

The last of Stanford's five computer facilities was the Campus facility which provided computing for anyone who did not qualify for service from the other four. The charter for the campus facility was to provide the greatest variety of services with the maximum flexibility, fast turnaround while being reliable and cost effective. Serving about 5,000 users and running between 10,000 and 12,500 jobs a week, the campus computer center 360/67, operating under OS MFT, was dynamically switched between real and virtual and back to real storage again, under systems modifications designed at Stanford about six years ago when

IBM's announced timesharing system failed to be efficient enough for us to be able to afford it.

The campus computer center staff also developed a "high speed" or "quick partition" service primarily for short jobs like student projects and homework. Although the timesharing system was available, the pricing policy and machine effectiveness of timesharing was such that the majority of jobs were, and still are, submitted through the card readers. This facility has a large staff of systems programmers dedicated to system maintenance and enhancement, and a large user services staff to provide a wide range of courses and consulting to help an extremely diverse user community make the best use of the system.

In summary, computing service at Stanford two years ago included five facilities: the hospital, university administration, medical school, SLAC and general academic facilities. Four appealed to particular user communities, and only one served a truly diverse group of users.

Organizational Change

The direction of change in organization of these facilities should be noted. Forces influencing this change in organization of the computing facilities were technological, programmatic, financial and managerial. While hospital data processing was doing patient billing, the university administrative facility was giving computing support to the medical clinics. There was a substantial amount of overlap in these functions. Many hospital patients were also clinic patients and many physicians who ran the clinics also had admitted patients. Consequently, the hospital systems staff embarked on a program to design a unified patient accounting system to handle all the bills and records, indicating that they needed to increase the size and, to some extent,

the character of their computing.

On the other hand, many of the physicians in the medical school who had developed systems on the ACME research computer, now sought computing services in a production rather than research and development mode. The hospital data processing department felt that many of these production services should be part of the centralized computing services, and viewed with some concern the initiation of independent systems in pathology where an XDS Sigma 3 was installed to run the pathology laboratory and maintain laboratory records. It was apparent that a large amount of data communication between the laboratory automation system and the financial billing system would be necessary. Similarly, a research program in the department of medicine on drug interaction initiated by Dr. Stanley Cohen needed to build a data base dependent in part upon drug administration data from all the patients at the Stanford Medical Center. He, too, had instituted an independent computer support based upon a DEC PDP 11/45, and had begun to build a data base for his drug interaction studies. Underlying all of this was the concern at Stanford medical center, as in many other centers, about a growing trend toward on-line hospital information systems. And although it was far from clear what kind of system Stanford would introduce, it was evident that a 360/40 or a 370/135 operating under a financial officer was an unlikely place for development of a university medical center and hospital system. In any event, the data processing department in the hospital which had begun to design an on-line admission system using an IBM product, CICS (Customer Information Control System), to give on-line access to some of their data bases, foresaw the need

to upgrade their computer facility from a 370/135 to a 370/145 and to move from a completely batch oriented environment to an on-line data base management style of computing.

Many of the same pressures, of course, were in operation at the ACME medical research facility. Both because of its design and some inherent unreliabilities and also because of its charge as a research project on advanced computing in medicine, the ACME system was not a suitable facility for production. The final irresistible force was the fact that the National Institute of Health informed the principal investigator that continuing support of the ACME facility as a service facility would be impossible.

Thus, the medical community, university hospital and medical school began an intensive study of computing needs and opportunities in the medical center. After studying the problem for some time, they proposed a central facility to serve all the medical center so that patient care data would be made available to physicians interested in primary care, to those interested in research questions and to those interested in the administration of the hospital and school. Administratively, these proposals were accorded a receptive hearing by Dr. Clayton Rich, the new dean of the medical schcol and vice president of the university for medical affairs. However, there were some difficulties with the funding of the center and some concern as to whether a facility in the medical center alone was the right step to take at that time. However, the need was acknowledged for a facility that would give top priority to reliability, provide on-line interactive computing including the language PL/ACME, provide extensive file management and data base support services and include provision for entering and

interacting with laboratory and other time oriented data both in research and patient care functions.

At the same time, at the linear accelerator, under an AEC major computer procurement cycle, SLAC was scheduled to receive two 370/168s during the fall of 1973 to augment the 360/91. In the procurement negotiations, SLAC had taken the position that computing would be central to effective physics. The required facility was slated to collect data directly from experiments, spool it directly into digital form, and allow selected interactive analysis by the experimenter of the data in sufficiently short time to modify the experiment while in progress. For back up and reliability, SLAC ordered a dual system. The computer system had to be up whenever the accelerator was up. Otherwise, SLAC priorities seemed entirely like those of the medical school. Also, the SLAC facility was moving out of the exclusive domain of physics. At the request of the director, various administrative functions for SLAC, including payroll and inventory control, were moved to the 360/91, so that many features of production schedules were being imposed on the 360/91.

On the university administration 370/145, the impact of Project INFO development was being felt. The on-line administrative system, OASIS, was being introduced for student services and alumni records (See Chapter 00). The direction in university administrative computing was toward reliable computing, with production schedules, but in a data base management environment and with on-line services.

In the campus facility, the general purpose academic computer, the trend was in much the same direction. A research program on information retrieval under the direction of Professor Edwin B. Parker

had led to a product called SPIRES which had been used as a basis for Stanford library automation. In 1972, project BALLOTS was undertaken to develop an on-line, machine based library system using the MARC file and also handling original cataloging in the university library. The assumption was made that if the computer was down, the library catalog department would be down.

The direction of motion in all five computing facilities was much the same. The more conservative management requirements that one would expect in business computing were evidences in the academic centers, and the administrative facilities were moving towards on-line, interactive computing.

When these facts were considered, the university administration decided to take advantage of Grosch's law, or, "It's cheaper by the dozen." For twice the investment, one can get four times the computing. If an organization needs more than twice the computing, the law seems still to be valid.

Computing Services 1973

In April of 1973, the university established the Stanford Center for Information Processing, or SCIP, to manage all five university service facilities under the directorship of Charles Dickens, former director of the SLAC facility, with Mike Roberts, who continues as director of the university administrative facility, as Deputy Director. SCIP has moved in the direction of establishing two rather than five geographic locations for computing. One is located at SLAC, which is some miles removed from the campus, and one at the central campus, interestingly enough in the neighborhood of the university library.

All computer operations have been placed under unified management. Soon there will be only three installations. The model 50 has been returned. A 370/158 has been established next to the 370/145 and the 370/135 will soon be released from the hospital. The entire medical center will then be using remote job entry and terminal oriented computing. The ACME system is installed on the 370/158. There is a single management for systems programming from all five facilities with a charter to use the temporarily excess hardware resources at SLAC for system development to develop a common environment (interactive services, data base management, real time services, and operating system) for the university as a whole.

Of course, there was before and there is now more to computing at Stanford than these services. For example, in the Graduate School of Business, an H-P 2000 runs BASIC for the MBA students with one operator and a faculty director. The computer is left running unattended nights and weekends, and is very cost effective. In the consolidation, Stanford University has brought together general purpose service computers while continuing to allow unique services. Between 40 and 50 minicomputers, particularly in laboratory support and real time service, will continue to represent the second law of economics in computing. Professor Cox of Washington University has asserted that if one knows what computing one wants, it can be had wholesale. Grosch's law and Cox's law are two primary forces at work at Stanford. The trick will be to get our computing cheaper by the dozen, but also to get it wholesale.